SEMICONDUCTOR CIRCUITS FOR 19-INCH (AND SMALLER) BLACK-AND-WHITE TELEVISION RECEIVERS

by Derek Bray

INTRODUCTION

With the recent development of integrated circuits and silicon Planar* horizontal and vertical output devices, it is now possible to construct a black-and-white TV receiver for all screen sizes up to and including 110-degree 19-inch tubes. The circuits considered in this application bulletin present one approach using state-of-the-art devices.

VIDEO IF AMPLIFIER

The video IF amplifier is a conventional three-stage amplifier with AGC control on the first two stages, Q_1 and Q_2, which are low-capacity forward AGC transistors specifically designed for this application.[1] Adjacent sound and adjacent picture carriers are trapped-out by the bifilar T trap at the input. A co-channel sound trap is provided in the collector circuit of Q_1. The third IF stage, Q_3, provides most of the IF selectivity and is a fixed gain stage utilizing a low feedback, high output impedance, transistor (SE5025), which has been specifically designed for the third IF stage.[2]

SIGNAL PROCESSING

An experimental integrated circuit is being used to provide the functions of video detector, IF AGC, tuner AGC, and sync separator in one package. No details are available on this circuit at this writing.

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* Planar is a patented Fairchild process.

1. See list of references at end of paper.

VIDEO OUTPUT STAGE

The video output stage, Q_4, provides an output capability of 100 volts peak-to-peak with a 3-MHz bandwidth into a 15-pf load. The output transistor, Q_4, is a low-capacity high-voltage transistor, SE7010. Contrast control and vertical blanking are provided in the emitter circuit of Q_4.

SOUND IF AMPLIFIER

The sound IF amplifier utilizes the recently introduced integrated circuit, μA703. The use of this circuit in sound IF circuits has been the subject of a recent application bulletin.[3] A 4.5-MHz tuned transformer at the input to the μA703 provides most of the desired selectivity. A ratio detector output provides some degree of AM rejection for low signal levels.

AUDIO AMPLIFIER

This is a conventional two-stage amplifier using a class-A output stage capable of an undistorted 1-watt sine-wave output. The driver stage, Q_5, is a conventional high-gain transistor, SE4002. The output stage is a new, 300-volt breakdown, silicon Planar* transistor (SE7020), which enables class-A line operation to be used without the need for large series dropping resistors.

Vertical Oscillator and Output Stage

This particular circuit is only one of many useful devices with equal performance. A sync pulse inverter stage,

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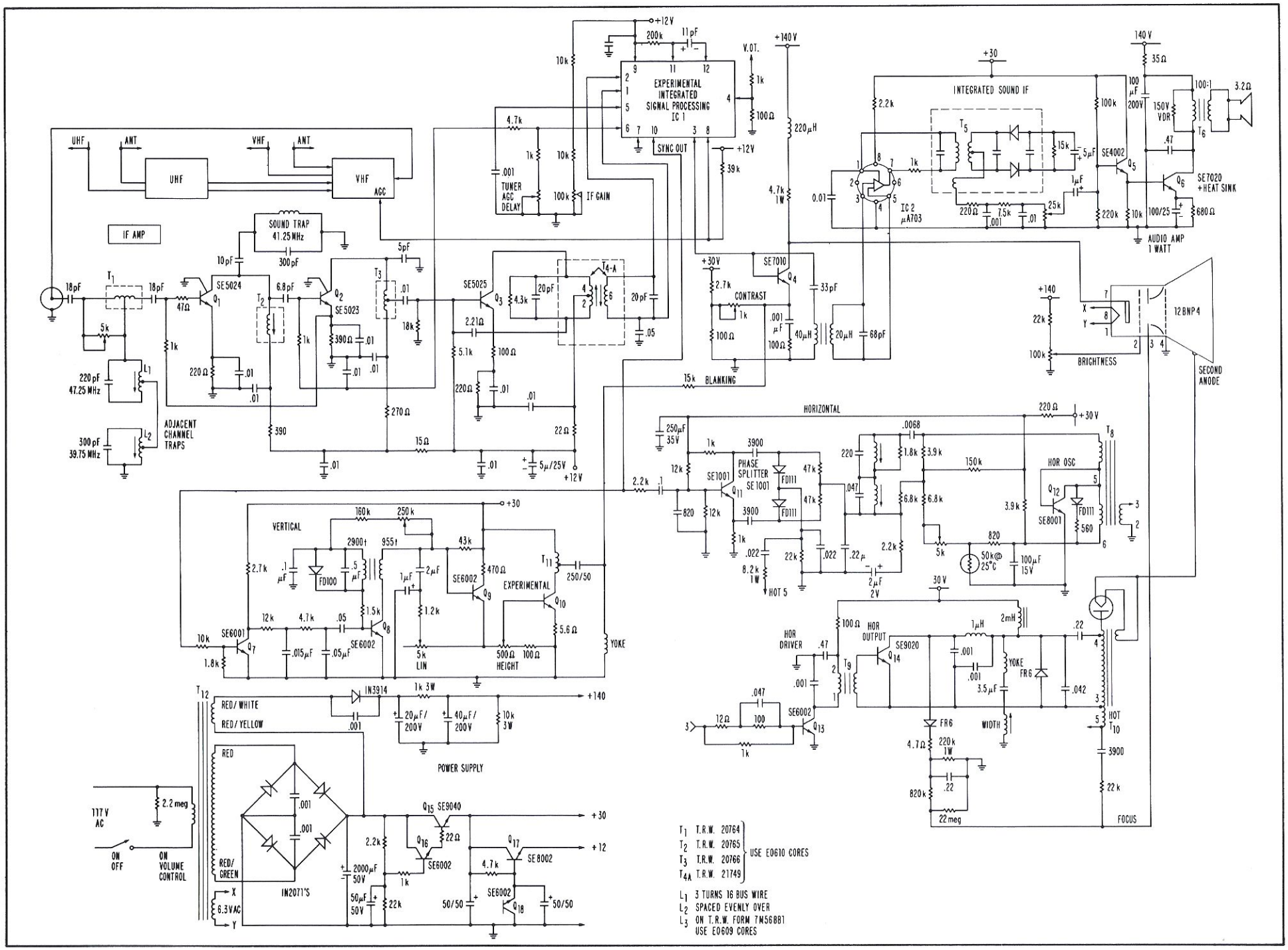

T1 T.R.W. 20764
T2 T.R.W. 20765
T3 T.R.W. 20766
T4A T.R.W. 21749
} USE E0610 CORES

L1 3 TURNS 16 BUS WIRE
L2 SPACED EVENLY OVER
L3 ON T.R.W. FORM 7M56881
USE E0609 CORES

Fig. 1. Semiconductor circuits for 19-inch black and white TV receivers.

Q_7 (SE6001), is used to provide positive polarity sync pulses. Q_8 (SE6002) is a triggered blocking oscillator providing the discharge path for the sawtooth generating capacitors. Q_9 (SE6002) is an emitter follower driver stage for the output transistor, Q_{10}. Q_{10} is an experimental 300-volt breakdown transistor with a capability of a 1-amp collector current at low saturation voltages. The output is choke capacity-coupled into the vertical yoke. Vertical blanking is obtained from the flyback valtage generated across the vertical yoke. Linearity, height, and vertical hold controls are provided in a conventional manner.

Horizontal Oscillator and Output Stage

Once again, this particular circuit is only one of many satisfactory circuits that have been used for this function. A phase splitter, Q_{11} (SE1001), is used to drive the sampling diodes in the horizontal APC detector. A horizontal sawtooth is generated by integration of the horizontal flyback pulse obtained from the horizontal output transformer. The dc voltage from the detector is used to control the frequency of a sine wave-stabilized, voltage-controlled oscillator, Q_{12} (SE6001). Provision is made for a horizontal hold control either by variation of the inductance in the base of Q_{12}, or by variation of the base bias on Q_{12}. The output of Q_{12} is transformer-coupled to the horizontal driver stage, Q_{13} (SE8001), which in turn is transformer-coupled to the horizontal output stage, Q_{14}.

A newly developed high-voltage silicon Planar* transistor, Q_{14} (SE9020), is specifically designed for this application. It is capable of withstanding a 400-volt flyback pulse and will conduct up to a 7-amp peak current with low saturation voltages. For protection against tube arcing,

TABLE I.
PARTIAL LIST OF FAIRCHILD SEMICONDUCTOR DEVICES.

CIRCUIT	TRANSISTORS		DIODES	
IF Amplifier	1st Stage	SE5024		
	2nd Stage	SE5023		
	Output	SE5025		
Signal Processing	Experimental Integrated Circuit			
Sound IF	Amplifier	μA703	Ratio Detector	2XFD111
Audio Amplifier	1st Stage	SE4002		
	Output	SE7020		
Video Amplifier	Output	SE7010		
Vertical	Inverter	SE6001		
	Oscillator	SE6002	Catcher Diode	FD111
	Driver	SE6002		
	Output	Experimental		
Horizontal	Phase Splitter	SE1001	APC Diode	FD111
	Oscillator	SE6001	Catching Diode	FD111
	Driver	SE8001		
	Output	SE9020	Focus Rectifier	FR6
			Damper Diode	FR6
Power Supply	30V Regulator	SE9040	Zener	SE6002
	Driver	SE6002		
	12V Regulator	SE8002		

a choke capacity-coupled output is used. With a suitable output transformer, high voltages in excess of 18 kilovolts can be generated with inherent protection against high voltage arcing conditions.

The damper diode (FR6) used in conjunction with the SE9020 is a newly developed silicon Planar* diode with a 400-volt breakdown capability. The same diode can be used to rectify the horizontal flyback pulse and provide a 400-volt focus voltage for the picture tube.

POWER SUPPLY

The primary power supply voltage of 30 volts for horizontal-vertical and video circuits is provided by a series ripple filter configuration, Q_{15} and Q_{16}, following a full-wave bridge rectifier. The SE9040, Q_{15}, is a high-power silicon Planar* transistor in which emitter metallization provides a large safe operating area. The driver stage, Q_{16} (SE6002), acts as an emitter follower to provide additional current gain for the ripple filter.

A low-current, zener-stabilized, 12-volt supply is used to supply the tuner, video IF, signal processing, and sound IF circuits. SE6002, Q_{18}, is a zener-connected transistor connected to the base of the series regulator, Q_{17} (SE8002).

An additional half-wave rectified supply of 140 volts provides the high-voltage requirements of the audio and video output stages.

CONCLUSION

A list of all Fairchild Semiconductor devices used, except for the tuners, is given in Table I. The use of integrated circuits will result in a degree of reliability and performance so far unobtainable with other types of devices. These circuits were demonstrated on a 12-inch receiver at the Chicago Spring Conference in June 1966.

ACKNOWLEDGMENTS

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REFERENCES

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